Cuttings Leaching System (CLS) Field Test Results

On September 8, 2015, Drake Water Technologies, Inc., in cooperation with NOV staff, deployed the CLS prototype unit to a Zavanna Rig Site west of Williston, North Dakota. Following deployment and shakedown, the prototype was operated successfully with the following field results:

- **>98% removal of salt** according to EC probes in the system
- **>98.8% chloride removal** by Cl^- ion specific electrode resulting in final chloride in solids of <1,000 mg/kg on a dry basis
- Chlorides in treated material leachate were **216 mg/L**, which is **less than the 250 mg/L specified by the ND Department of Health**
- Sampled product was taken for a maximum throughput run averaging **612 lb mass per hour**, which is **>20% above system design throughput of 500 lb** mass per hour.
- Dewatering screw product exhibited 20% moisture by mass
- CLS system design was tolerant of upsets and recovered quickly from upsets.

Laboratory results from a post-treatment sample collected during a CLS run (see attached graph) by Dennis Fewless, ND Department of Environmental Health, resulted in a **chloride** from the treated cuttings of **120 mg/L, less than half the limit set by ND DEH**.

Laboratory analyses from several samples collected by NOV staff during several runs resulted in an **average chloride of 57,315 mg/L in the feed materials** (both centrifuge and shaker cuttings) and an **average of 672 mg/L in the treated material**. The result is a 98.8% removal of chloride.

Follow up analysis from materials DWT brought back to Helena from the final run on September 17th, showed **2,200 mg/L chloride in the feed material with 13 mg/L in the treated material**. The result is a **99.4% removal of chloride**. While there are differences in the resulting numbers from a variety of samples, most likely due to different techniques employed by the laboratories, the results are very good. The CLS unit is in storage at NOV's Dickinson's facility, and the dewatering screw has been removed for separate testing.